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Cleaning tests of the ESR foil

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The DarkSide experiment has been designed to search for direct interactions of the cold dark matter particles. Due to the expected very low signal, different techniques have been implemented to minimize the background. Currently the DarkSide-20k (DS-20k) detector is under construction in the underground laboratory at Gran Sasso (LNGS) in Italy.

One of the material which is going to be used in the DS-20k detector is the ESR foil. It is light highly reflecting and covered with the wavelength shifter (TPB) foil which will be used to maximize the light detection in the TPC. Due to its large surface applied (some hundred square meters) and close proximity to the active volume its surface must be extremely radiopure, mainly with respect to Pb-210. The long-lived Pb-210 ($T_{1/2} = 22$ yr) decays through Bi-210 to Po-210. The last is an alpha emitter, which in the (α, n) reactions may produce neutrons. Interaction of neutrons are indistinguishable from those caused by the dark matter particles. Due to the low energy of gammas emitted in the Pb-210 decays (46.5 keV), low Pb-210 activities are usually established by a series of Po-210 measurements. The DS-20k requirements for the Pb-210 surface specific activity for the ESR foil is: $C = 0.04$ mBq/m². The value measured by the XIA UltraLo-1800 alpha spectrometer is comparable with the spectrometer's background, ≤ 0.4 mBq/m². Due to this fact, a cleaning technique which reduces the Pb-210 activity by a factor of 10 is needed. The ESR samples were contaminated with Pb-210 in a strong Rn source and then different cleaning methods were tested: cleaning by chemical solutions (i.e. isopropanol, HCl, citric acid) and plasma cleanings (atmospheric, vacuum). Cleaning by using chemical solutions and the atmospheric plasma technique occurred to be ineffective. Obtained Pb-210 reduction factors for the atmospheric plasma cleaning were 1.2 ± 0.2 and 0.9 ± 0.1 . Pb-210 reduction factors obtained for the ESR samples treated by the vacuum plasma cleaning (two runs) are 4.8 ± 0.7 and 6.2 ± 0.8 . More details about the method and analysis will be outlined in the short talk foreseen for PhD students. Detailed description will be given on the poster.

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